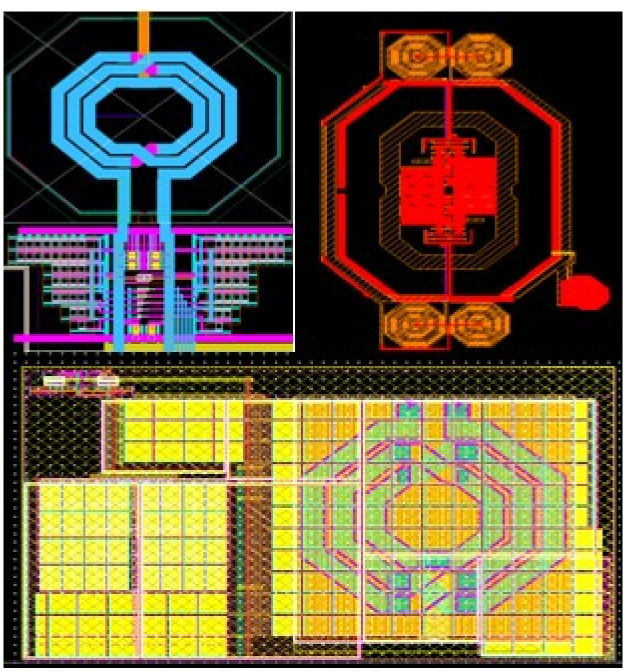
High Frequency Designer (HFD)

Overview

PeakView™ HFD™ is an electromagnetic and parasitic inductance extraction tool for evaluating the electromagnetic behavior of critical signal paths in high-speed designs. At microwave and millimeter wave frequencies, full-wave electromagnetic (EM) modeling of interconnect routing becomes indispensable to accurately characterize the parasitic inductive (L) effects of these structures. Today's common LPE flow only focuses on R and C extraction while missing the L parasitic components. HFD™ will fill the gap for such insufficiencies in LPE solutions, by using PeakView™ EM engine to simulate and model the selected interconnect geometries. Upon completion of Calibre LVS run, users can proceed with their RC extraction flow. After selecting critical nets and coupled devices in Virtuoso schematic or layout views, HFD will automatically separate the selected nets from the design with Calibre's svdb and electromagnetically simulate the corresponding interconnect geometries using PeakView™ EM engine. Finally, the interconnect EM models will be automatically back-annotated to the original post-layout parasitic extracted views for netlisting and simulation.



HFD application: VCO critical net in compact RF

Benefits

Accuracy & Performance

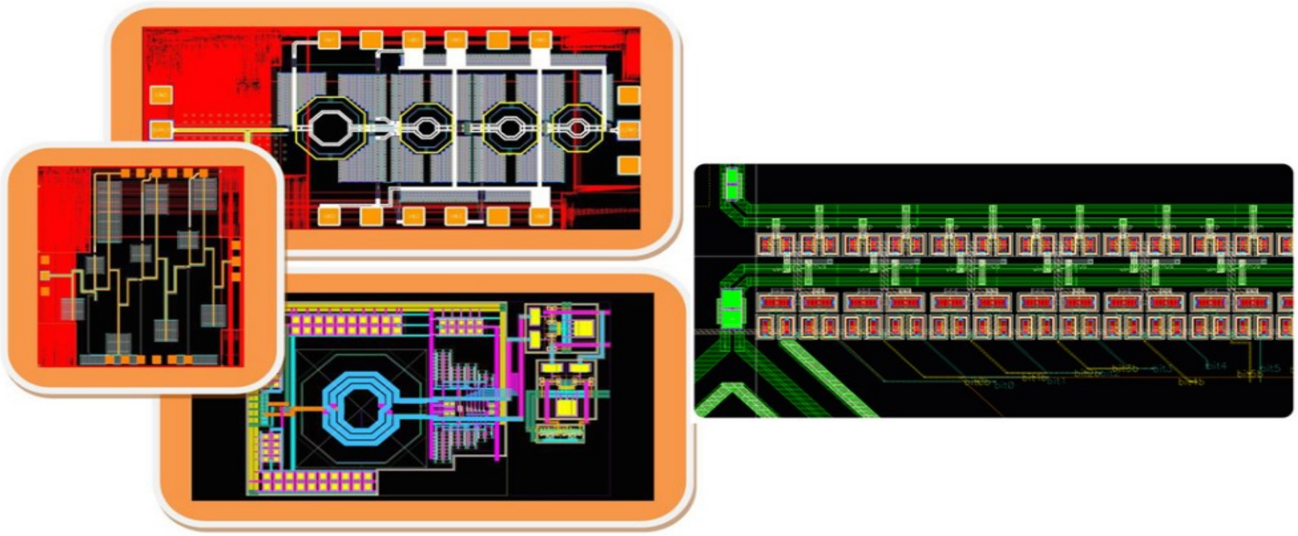
HFD™ utilizes the PeakView™ full-wave EM simulation technology to analyze critical interconnects. It provides an electromagnetic model complete with parasitic inductive, resistive, capacitive effects and substrate losses. Users can further selectively apply any combination of parasitic effects (L, R and C from either PeakView RLC or original LPE extracted RC) to their circuit simulations. PeakView's patented EM solver combines high accuracy; computational performance and capacity needed to analyze devices and circuit interconnect for industry standard design flows.

Automation and Flow Integration

PeakView HFD™ is integrated into Virtuoso® schematic and layout editors and customary RC extraction flows. This enables designers to work within a familiar IC design environment. Designers can select nets from the schematic or layout editor. HFD then prepares them for net extraction, pin insertion for simulation, model generation and back-annotation. HFD manages all of the details behind the scenes and automatically ensures design data integrity while including the effects of EM coupling in circuit simulations.

Wide Applications

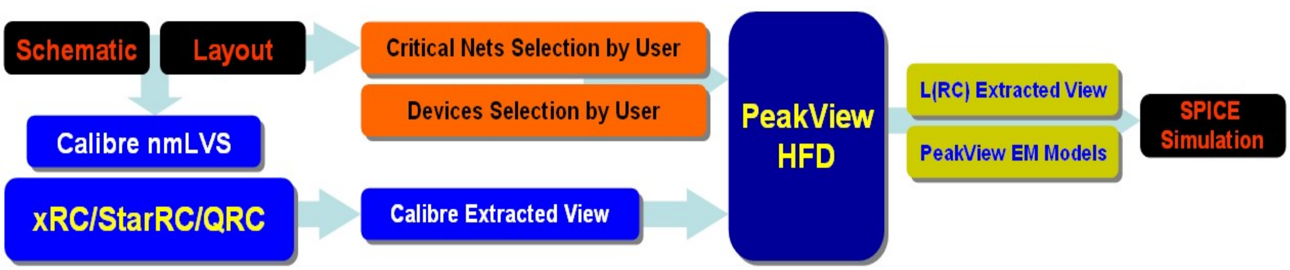
PeakView HFD places special emphasis on electromagnetic coupling effects present in a wide range of RFIC transmission media. In addition, it excels in accounting for skin effect losses not considered by traditional RC extraction tools. HFD is being adopted in analyzing critical interconnect components for voltage controlled oscillators (VCO), low-noise amplifiers (LNA), power amplifiers (PA), differential transmission lines, CPW lines, micro-strip lines, digital clock lines and a host of other high-frequency integrated systems. It is highly suitable for millimeter-wave radar applications at 77 GHz and 94 GHz bands.

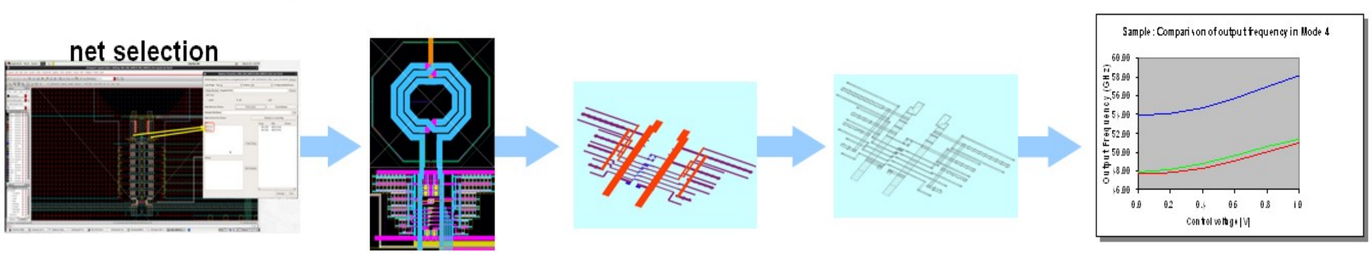


Left: High-frequency signal nets in power amplifiers (PAs), low noise amplifiers (LNAs) and voltage-controlled oscillators (VCOs) (courtesy of TSMC RDK) Right: Millimeter Wave interconnect design, (courtesy of Stanford University)

HFD™ Flow

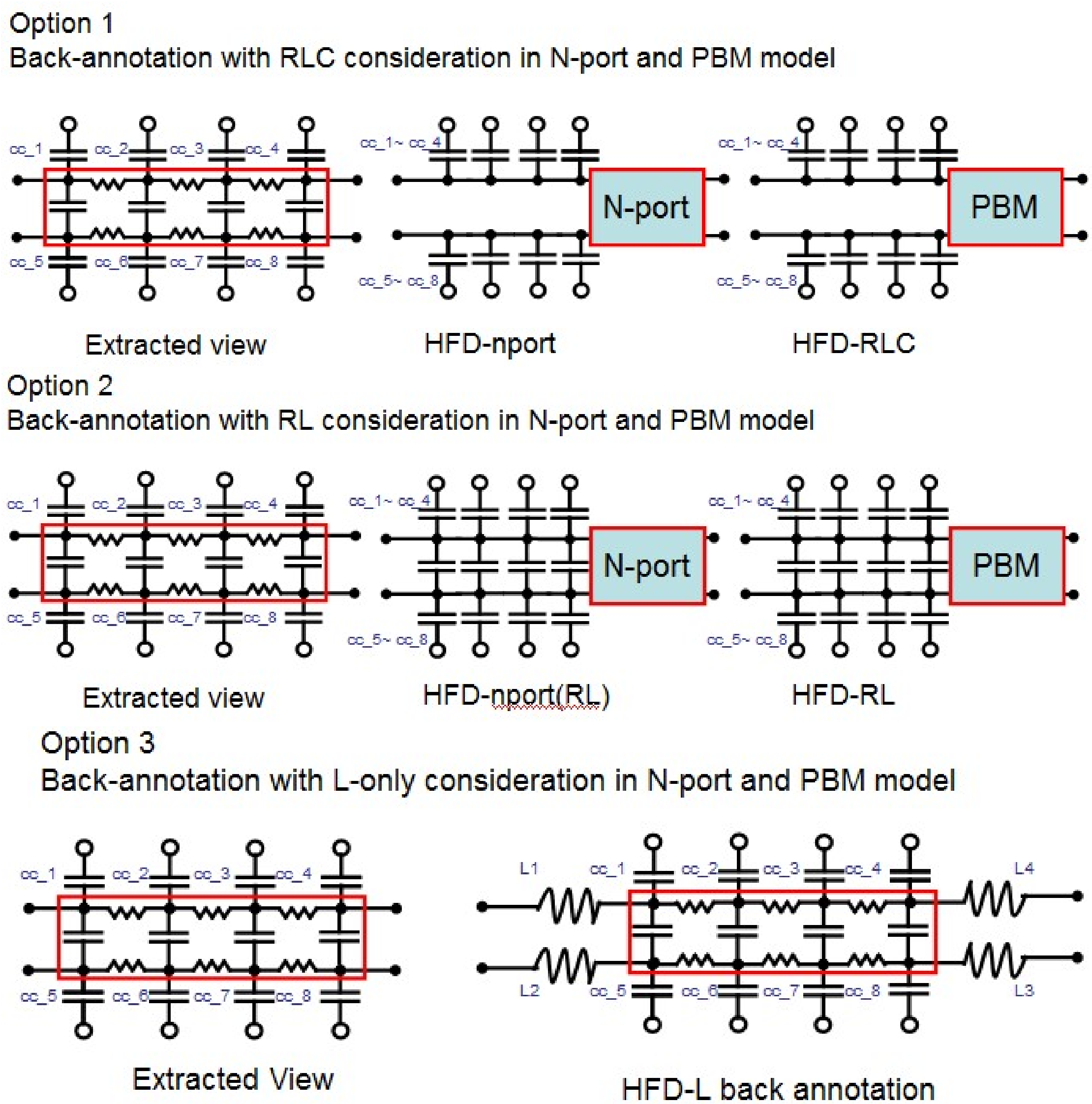
PeakView HFD™ is compatible with Calibre LVS™ and standard LPE flows for ease of use in the Cadence® design environment. Users have the choice to select critical nets and devices of interest from either their schematic or layout. Interconnect EM models will be generated by HFD and then back-annotated to the LPE generated extracted view and ready for SPICE simulation.





Net and Device selection in schematic or layout, and corresponding geometry in PeakView HFD

Powerful Back-Annotation Options



High Performance & Capacity Advantages

1. Fastest Full-Wave EM Engine for Performance, Capacity and Accuracy

PeakView™ EM solver provides the accuracy, performance and capacity needed to prepare devices and circuit interconnect for the latest industry standards. The PeakView™ simulation engine typically runs upto 10x faster than traditional structure simulators while maintaining correlated accuracy. It is designed to handle the complex structures found in today's on-chip devices. Its special meshing algorithm takes into account advanced process nodes with tall side-walls, high frequency skin effects and thick metal layers for superior quality EM results. HFD has the capacity to efficiently handle a large assortment of interconnects with hundreds of ports to generate accurate electromagnetic models.

2. Customized Accuracy Tuning

In addition to pre-configured EM simulation types, PeakView™ has implemented Customized Accuracy Type to enhance the flexibility of accuracy settings and to configure layout processing and EM simulation options. By composing a configuration file, users are able to easily tune the tool such that the entire EM simulation process is optimized for special test cases. This is particularly useful for scenarios where concurrent simulation for structures of varying scales is required.

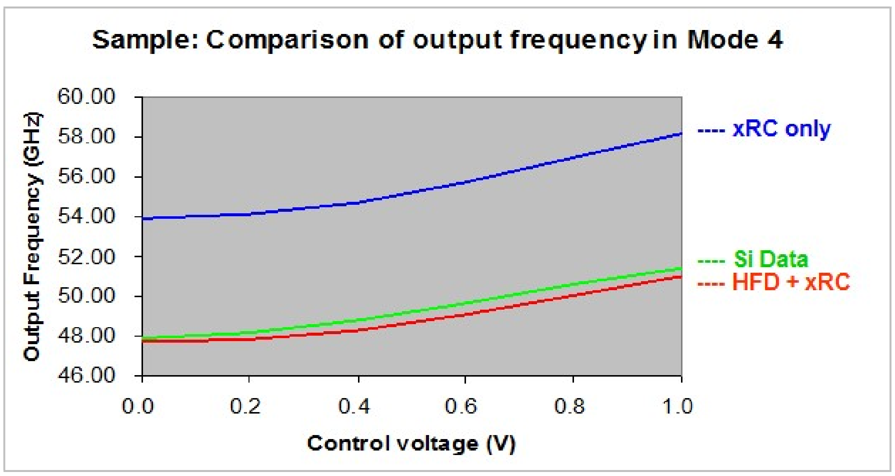
3. Multi-core Processing and Distributed Computing

In order to maximize utilization of computing resources, LEM™ takes advantage of PeakView's multi-core processing capability. Design jobs can be run on compute farms consisting of multi-core machines, as well as on standalone platforms with multi-core processor to achieve maximum parallel efficiency via multi-threading. PeakView provides different distributed computing modes to concurrently accelerate the EM modeling. Users are able to specify different frequency points to be simulated on different machines in a compute farm.

Silicon Data Correlation

HFD simulations capturing parasitic influences from DC to 60 GHz and beyond continues to demonstrate excellent correlation to silicon data in advanced process nodes deployed in major wireless companies and foundries.

The HFD flow has been demonstrated on RF Reference Design Kits from TSMC, where the results have been validated to match silicon from 40 GHz to 60 GHz. Lorentz Solution, Inc. has also collaborated with Stanford University on research projects where HFD results correlated very well with silicon measurements in the range of 50-70 GHz.



50 GHz VCO output frequency comparison (Silicon data courtesy of TSMC)

HFD has been benchmarked by our high-frequency, RF and mixed-signal IC design customers to be the most reliable and efficient electromagnetic extraction tool to date. It is also emerging as a revolutionary millimeter wave technology aiding in the design and verification of broadband gigabits per second (Gbps) on-chip wireless systems. Full-scale implementation of this technology will greatly facilitate research and development in the 5G (5th Generation wireless network) standards and associated hardware, where millimeter wave frequency bands are of primary interest.

Standard Format Support

HFD Setup

iRCX format technology file from TSMC

ITF format technology file from foundries

HFD Input

Calibre LVS® clean design

PEX: Calibre xRC®/Synopsis StarRC™/Cadence® QRC results in extracted view

HFD Output

Cadence® format (OA/CDBA) PeakView extracted view, ready for circuit simulation

Platform

Linux 64-bit, i.e. Red Hat and SUSE

LSF/NC-based computing farm